

DEPARTMENT OF THE INTERIOR

CANADA

HON. W. J. ROCHE, *Minister.*

W. W. CORY, C.M.G., *Deputy Minister.*

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OTTAWA

W. F. KING, C.M.G., LL.D., *Director.*

Vol. II, No. 6

Orbit of ζ Andromedæ

BY

J. B. CANNON, M.A.

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ORBIT OF ξ ANDROMEDÆ.

BY J. B. CANNON, M.A.

Four measures of the velocity of this star are given in L.O.B. 199, the range of the four being 35 km. The spectral type is K, but the lines are not so good as is usually the case with stars of this type. The note added to the list of measures in L.O.B. 199 says that "the lines are rather broad, possibly due to the effect of a second spectrum." This may be the cause of the broadness of the lines, although no indication of doubling has been observed here in any case. Fifty-eight plates were used in the work of determining the orbit, dating from Sept. 1st, 1913, to Feb. 12th, 1915. On the average, about 12 lines were measured on each plate and, generally speaking, the agreement was very fair. A list of the lines used and the element to which each is due follows in Table I.

TABLE I.

Wave-Length.	Element	Wave-Length.	Element.
4571.958	Ti	4260.640	Fe
4549.721	Fe	4227.066	Fe
4534.139	Ti	4216.028	Fe
4501.814	Ti	4215.849	Fe
4415.271	Fe	4202.161	Fe
4404.962	Fe	4143.928	Fe
4395.505	Ti-V	4130.950	Si
4352.006	Cr-Mg	4128.031	Si
4340.798	H	4101.820	H
4325.939	Fe	4077.885	Sr
4314.945	Fe-Ti	4071.927	Fe
4294.528	Ti-Fe	4063.849	Fe
4289.857	Cr	4045.975	Fe
4271.874	Fe	4005.422	Fe

A summary of the measures is given in Tables II and III. Table II contains the Lick measures. The four above mentioned are here, and also another taken in 1911 and communicated by Dr. Campbell. Table III contains the Ottawa observations. In these tables, the phase is from periastron and the residual from the final curve.

TABLE II.
LICK OBSERVATIONS.

Julian Day	Phase.	Velocity.	Residual.
2,414,582-751	12-431	- 21.4	+ 1.0
2,416,820-764	11-764	- 15.7	+ 1.0
2,417,501-757	17-600	- 51.3	+ 5.1
2,418,206-893	12-044	- 18.2	+ 1.0
2,419,335-679	3-723	- 28.0	+ 6.5

TABLE III.
OTTAWA OBSERVATIONS.

Plate	Observer*	Date	Exposure	Julian Day	Phase	Vel.	Wt.	Residual
		1913	m.					
5657	Y	Sept. 1	68	2,420,012-782	5-606	- 19.4	7	- 1.0
5681	Pi	Sept. 19	40	030-760	5-879	- 17.8	4	- 2.2
5689	C	Sept. 22	80	033-853	8-972	- 6.1	4	- 0.9
5715	C	Sept. 29	75	040-825	15-944	- 45.3	8	+ 5.7
5737	C-Pi	Oct. 3	75	044-750	2-102	- 43.3	8	+ 5.0
5754	C	Oct. 6	75	047-783	5-143	- 27.3	4	- 4.8
5777	C	Oct. 13	75	054-690	12-041	- 20.8	5	- 1.6
5856	P	Dec. 27	35	129-533	15-815	- 57.7	3	- 7.7
5860	P	Dec. 31	50	133-552	2-066	- 47.1	4	+ 1.2
		1914						
5875	Pi	Jan. 5	60	138-538	7-053	- 3.8	6	+ 5.4
5882	Pi	Jan. 12	60	145-576	14-091	- 45.9	3	- 9.1
6246	C	Aug. 3	75	348-859	4-167	- 38.2	6	- 7.2
6269	C	Aug. 5	75	350-862	6-169	- 22.5	4	- 8.1
6302	Y-C	Aug. 24	79	369-747	7-287	- 7.3	8	+ 0.8
6315	C	Aug. 26	90	371-809	9-349	- 7.3	3	- 1.6
6338	Pi	Sept. 4	75	380-817	0-590	- 60.4	8	- 5.0
6372	C	Sept. 14	75	390-792	10-565	- 10.8	8	- 1.2
6385	G	Sept. 16	85	392-692	12-465	- 19.4	6	+ 3.0
6401	C-Pi	Sept. 18	75	394-724	14-497	- 35.3	8	+ 4.7

OTTAWA OBSERVATIONS—Continued.

Plate	Observer*	Date	Exposure	Julian Day	Phase	Vel.	Wt.	Residual
		1914.	m.					
6411	P ⁱ	Sept. 20.	90	2,429,396.778	16.551	- 47.4	8	+ 6.6
6417	H-C	Sept. 21.	79	397.729	17.502	- 59.0	7	- 2.5
6429	G	Sept. 25.	70	401.806	3.812	- 33.8	8	+ 0.7
6441	C	Sept. 28.	75	404.751	6.756	- 16.5	7	- 5.7
6446	G	Sept. 30.	80	406.625	8.630	- 11.3	6	- 5.1
6457	H-Y	Oct. 1.	55	407.726	9.731	- 1.4	4	+ 5.0
6466	C	Oct. 2.	65	408.641	10.646	- 2.3	7	+ 7.6
6478	Y	Oct. 4.	64	410.583	12.588	- 23.4	8	+ 0.1
6494	C	Oct. 12.	77	418.789	3.027	- 47.5	4	- 6.7
6498	Y	Oct. 13.	70	419.653	3.891	- 29.4	5	+ 4.1
6505	P ⁱ	Oct. 14.	65	420.665	4.903	- 32.7	5	- 8.5
6507	Y-H	Oct. 20.	90	426.729	10.967	- 10.5	6	+ 1.3
6515	P ⁱ	Oct. 21.	90	427.757	11.995	- 25.5	7	- 6.9
6523	Y	Oct. 22.	60	428.792	13.030	- 25.9	7	+ 1.6
6530	C	Oct. 23.	75	429.592	13.830	- 38.4	8	- 4.2
6544	P ⁱ -C	Nov. 2.	70	439.729	6.200	- 14.5	5	- 0.5
6551	C	Nov. 4.	75	441.634	8.105	- 3.5	6	+ 2.2
6558	P ⁱ	Nov. 16.	105	453.675	2.379	- 46.4	8	- 0.4
6560	Y	Nov. 17.	83	454.638	3.342	- 35.5	8	+ 3.3
6570	C	Nov. 23.	70	460.625	9.329	- 4.3	7	+ 1.4
6581	C	Nov. 27.	75	464.636	13.340	- 33.4	6	- 4.1
6585	P ⁱ	Nov. 28.	65	465.520	14.233	- 38.5	6	- 0.5
6590	C	Dec. 4.	85	471.564	2.505	- 40.9	8	+ 4.1
6614	C	Dec. 11.	75	478.567	9.503	- 9.4	7	- 3.4
6637	H	Dec. 16.	96	483.665	14.601	- 40.4	8	+ 0.4
6647	Y	Dec. 20.	70	487.536	0.705	- 58.2	8	- 3.2
6648	P ⁱ	Dec. 21.	80	488.684	1.853	- 52.5	7	- 2.5
6649	Y	Dec. 22.	60	489.460	2.638	- 40.5	7	+ 3.5
6662	H	Dec. 26.	60	493.433	6.664	- 5.5	7	+ 5.6
		1915						
6675	Y	Jan. 3.	60	501.540	14.709	- 41.0	8	+ 0.5
6676	P ⁱ	Jan. 4.	75	502.522	15.691	- 47.6	7	+ 1.9
6684	Y	Jan. 5.	60	503.483	16.642	- 57.7	8	- 2.9
6690	C	Jan. 8.	70	506.538	1.940	- 43.4	6	+ 6.0
6724	H	Jan. 21.	45	519.460	14.862	- 44.2	5	- 1.3
6728	Y	Jan. 24.	70	522.472	0.107	- 55.0	6	+ 1.2
6772	H	Feb. 4.	60	533.492	11.126	- 6.6	5	+ 5.9
6775	Y	Feb. 9.	60	538.490	16.124	- 55.2	8	- 3.2
6779	H	Feb. 10.	83	539.522	17.156	- 60.1	6	- 4.1
6780	C	Feb. 12.	63	541.495	1.362	- 54.4	8	- 1.8

*Y=Young, Pⁱ=Parker, C=Cannon, P=Faskett, G=Gibson, H=Harper.

The detailed measures of the plates are now given.

MEASURES OF ξ ANDROMEDÆ.

λ	5657		5681		5689		5715		5737		5754		5777	
	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.
4571.958	- 6.71	$\frac{1}{2}$	- 28.17	$\frac{1}{2}$	- 26.79	$\frac{1}{2}$	- 63.27	$\frac{1}{4}$	- 52.61	$\frac{1}{2}$	- 28.17	$\frac{1}{2}$	- 12.40	$\frac{1}{4}$
4549.721	- 25.60	$\frac{1}{4}$			- 13.50	$\frac{1}{4}$	- 43.88	$\frac{1}{4}$					- 20.18	$\frac{1}{4}$
4501.814							- 63.18	$\frac{1}{2}$						
4415.271									- 50.04	$\frac{1}{2}$	- 40.80	$\frac{1}{2}$	- 2.99	$\frac{1}{4}$
4404.962	- 40.32	$\frac{1}{2}$			- 15.91	$\frac{1}{2}$	- 57.39	$\frac{1}{2}$	- 46.63	$\frac{1}{4}$	- 28.98	$\frac{1}{4}$	- 17.49	$\frac{1}{4}$
4395.505	- 48.77	$\frac{1}{2}$												
4352.006					- 13.27	$\frac{1}{4}$	- 23.96	$\frac{1}{2}$						
4340.798	- 37.58	$\frac{1}{2}$	- 27.54	$\frac{1}{2}$	- 8.79	$\frac{1}{4}$	- 51.96	$\frac{1}{4}$	- 48.77	$\frac{1}{2}$	- 34.93	$\frac{1}{2}$	- 10.50	$\frac{1}{4}$
4325.939	- 45.56	$\frac{1}{2}$	- 20.78	$\frac{1}{4}$	- 1.37	$\frac{1}{2}$	- 51.76	$\frac{1}{4}$	- 45.11	$\frac{1}{4}$	- 29.92	$\frac{1}{4}$	- 29.51	$\frac{1}{4}$
4314.945					- 26.79	$\frac{1}{4}$			- 52.89	$\frac{1}{2}$	- 15.10	$\frac{1}{2}$	- 19.98	$\frac{1}{2}$
4289.857	- 29.95	$\frac{1}{4}$			- 14.95	$\frac{1}{4}$	- 57.88	$\frac{1}{4}$	- 44.86	$\frac{1}{4}$			- 15.51	$\frac{1}{4}$
4260.640							- 60.00	$\frac{1}{4}$	- 53.31	$\frac{1}{2}$	- 26.32	$\frac{1}{4}$	- 13.60	$\frac{1}{2}$
4227.066	- 34.77	$\frac{1}{4}$	- 31.23	$\frac{1}{4}$			- 45.44	$\frac{1}{4}$	- 32.18	$\frac{1}{4}$			- 16.54	$\frac{1}{4}$
4216.028	- 46.64	$\frac{1}{2}$					- 42.06	$\frac{1}{2}$	- 47.18	$\frac{1}{4}$				
4215.849									- 38.08	$\frac{1}{2}$				
4143.928	- 40.89	$\frac{1}{4}$					- 57.54	$\frac{1}{4}$	- 39.80	$\frac{1}{4}$				
4130.950	- 45.48	$\frac{1}{2}$							- 48.01	$\frac{1}{4}$			- 21.43	$\frac{1}{4}$
4128.031														
4101.820	- 45.59	$\frac{1}{4}$					- 56.25	$\frac{1}{4}$	- 40.50	$\frac{1}{4}$			- 9.81	$\frac{1}{4}$
4077.885									- 45.72	$\frac{1}{4}$				
4071.927	- 18.71	$\frac{1}{4}$												
Weighted mean	- 36.88		- 28.23		- 14.68		- 50.65		- 46.73		- 29.25		- 14.83	
V_a	+ 17.75		+ 10.39		+ 8.99		+ 5.74		+ 3.86		+ 2.39		+ 5.69	
V_d	- .06		- .04		- .18		- .18		- .09		- .14		- .02	
Curv.	- .28		- .28		- .28		- .28		- .28		- .28		- .28	
Radial Velocity	- 19.4		- 17.8		- 6.1		- 45.3		- 43.2		- 27.3		- 20.8	

MEASURES OF ξ ANDROMEDÆ.—Continued.

λ	5856		5860		5875		5882		6246		6269		6302	
	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.
4571.958	- 23.12	$\frac{1}{2}$	- 21.52	$\frac{1}{2}$	+ 26.52	$\frac{1}{2}$	.....	.....	- 84.07	$\frac{1}{4}$	- 51.18	$\frac{1}{2}$	- 35.93	$\frac{1}{4}$
4549.721	- 31.04	$\frac{1}{4}$	- 8.86	$\frac{1}{4}$	+ 32.26	$\frac{1}{4}$	- 22.87	$\frac{1}{4}$	- 68.62	$\frac{1}{4}$	.....	.....	- 31.16	$\frac{1}{4}$
4415.271	.....	.....	.....	.....	+ 29.40	$\frac{1}{2}$	- 10.25	$\frac{1}{2}$	.....	.....	.....	.....	.....	.....
4404.962	.....	.....	.....	.....	+ 29.68	$\frac{1}{2}$	.....	.....	.....	.....	.....	.....	.....	.....
4395.505	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	- 35.39	$\frac{1}{4}$
4352.006	.....	.....	.....	.....	.....	.....	- 5.05	$\frac{1}{4}$	.....	.....	.....	.....	.....	.....
4340.798	- 39.91	$\frac{1}{4}$	- 17.87	$\frac{1}{2}$	+ 16.78	$\frac{1}{2}$	- 18.78	$\frac{1}{4}$	- 62.16	$\frac{1}{4}$	- 40.20	$\frac{1}{4}$	- 17.59	$\frac{1}{2}$
4325.939	.....	.....	- 9.79	$\frac{1}{4}$	+ 34.30	$\frac{1}{4}$	- 32.17	$\frac{1}{4}$	- 51.86	$\frac{1}{4}$	- 29.38	$\frac{1}{4}$	- 18.70	$\frac{1}{2}$
4314.945	.....	.....	- 20.04	$\frac{1}{2}$	+ 17.88	$\frac{1}{2}$	- 19.49	$\frac{1}{4}$	- 65.69	$\frac{1}{4}$	- 38.97	$\frac{1}{4}$	- 28.46	$\frac{1}{4}$
4294.528	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	- 28.83	$\frac{1}{2}$
4289.857	.....	.....	.....	.....	+ 34.32	$\frac{1}{4}$	.....	.....	- 50.13	$\frac{1}{4}$	- 66.39	$\frac{1}{2}$	- 39.26	$\frac{1}{4}$
4260.640	.....	.....	- 20.58	$\frac{1}{2}$	+ 33.40	$\frac{1}{4}$	.....	.....	.....	.....	- 53.92	$\frac{1}{4}$	- 24.59	$\frac{1}{4}$
4227.066	.....	.....	.....	.....	+ 15.50	$\frac{1}{2}$	.....	.....	.....	.....	.....	.....	- 31.17	$\frac{1}{2}$
4202.161	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	- 20.00	$\frac{1}{4}$
4101.820	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	- 22.00	$\frac{1}{2}$
4077.885	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	- 35.81	$\frac{1}{2}$
4063.849	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	- 23.68	$\frac{1}{4}$
Weighted mean	- 29.30		- 18.27		+ 25.36		- 16.97		- 63.75		- 49.70		- 27.74	
V_a	- 28.06		- 28.47		- 28.76		- 28.42		+ 25.85		+ 25.48		+ 20.61	
V_d	- .11		- .10		- .18		- .23		+ .02		+ .01		+ .11	
Curv.	- .28		- .28		- .28		- .28		- .28		- .28		- .28	
Radial Velocity	- 57.7		- 47.1		- 3.8		- 45.9		- 38.2		- 24.5		- 7.3	

MEASURES OF ξ ANDROMEDAE.—*Continued.*

λ	6315		6338		6372		6385		6401		6411		6417	
	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.
4571-958	- 40.84	$\frac{1}{2}$	- 82.21	$\frac{1}{4}$	- 23.74	$\frac{1}{4}$	- 29.30	$\frac{1}{2}$	- 35.14	$\frac{1}{2}$	- 37.92	$\frac{1}{2}$	- 77.84	$\frac{1}{4}$
4549-721	- 37.36	$\frac{1}{2}$	- 88.35	$\frac{1}{2}$	- 20.26	$\frac{1}{4}$			- 38.03	$\frac{1}{2}$	- 43.00	$\frac{1}{4}$	- 87.83	$\frac{1}{4}$
4501-814											- 54.95	$\frac{1}{2}$		
4415-271			- 79.14	$\frac{1}{4}$	- 24.92	$\frac{1}{2}$			- 52.12	$\frac{1}{4}$	- 42.36	$\frac{1}{4}$	- 60.10	$\frac{1}{2}$
4404-962			- 71.57	$\frac{1}{2}$					- 48.66	$\frac{1}{2}$	- 59.40	$\frac{1}{2}$	- 54.09	$\frac{1}{2}$
4395-505			- 64.93	$\frac{1}{4}$			- 40.67	$\frac{1}{4}$	- 40.06	$\frac{1}{4}$				
4340-798	- 29.95	$\frac{1}{4}$	- 66.10	$\frac{1}{4}$	- 30.06	$\frac{1}{2}$	- 37.50	$\frac{1}{2}$	- 52.47	1	- 66.88	$\frac{1}{4}$	- 75.33	$\frac{1}{2}$
4325-939			- 75.68	$\frac{1}{4}$	- 32.28	$\frac{1}{4}$	- 21.48	$\frac{1}{4}$	- 50.75	$\frac{1}{4}$	- 69.01	$\frac{1}{4}$	- 67.67	$\frac{1}{2}$
4314-945	- 9.36	$\frac{1}{4}$	- 79.38	$\frac{1}{2}$	- 34.00	$\frac{1}{2}$	- 25.83	$\frac{1}{2}$	- 49.35	$\frac{1}{2}$	- 60.17	$\frac{1}{2}$	- 53.87	$\frac{1}{4}$
4294-528			- 72.31	$\frac{1}{2}$										
4289-857					- 13.87	$\frac{1}{2}$			- 34.23	$\frac{1}{2}$	- 60.33	$\frac{1}{2}$	- 81.23	$\frac{1}{2}$
4271-874					- 24.13	$\frac{1}{2}$	- 32.67	$\frac{1}{4}$	- 43.14	$\frac{1}{2}$	- 58.84	$\frac{1}{2}$	- 73.58	$\frac{1}{2}$
4260-640			- 78.59	$\frac{1}{4}$										
4216-028	- 15.02	$\frac{1}{2}$												
4215-849			- 81.27	$\frac{1}{4}$	- 19.74	$\frac{1}{2}$	- 35.46	$\frac{1}{2}$	- 44.24	$\frac{1}{2}$	- 63.64	$\frac{1}{2}$	- 64.56	$\frac{1}{2}$
4128-031					- 20.97	$\frac{1}{4}$								
4101-820					- 13.28	$\frac{1}{2}$			- 67.38	$\frac{1}{4}$	- 60.42	$\frac{1}{4}$		
4063-849					- 24.04	$\frac{1}{4}$	- 31.58	$\frac{1}{2}$					- 63.15	$\frac{1}{2}$
4045-975											- 62.96	$\frac{1}{2}$		
Weighted mean	- 26.91		- 76.74		- 23.23		- 32.08		- 46.08		- 57.05		- 68.36	
V_a	+ 19.94		+ 16.72		+ 12.67		+ 11.85		+ 10.96		+ 10.04		+ 9.61	
V_d	- .02		- .08		- .08		+ .10		+ .04		- .09		+ .02	
Curv.	- .28		- .28		- .28		- .28		- .28		- .28		- .28	
Radial Velocity	- 7.3		- 60.4		- 10.9		- 19.4		- 35.3		- 47.4		- 59.0	

MEASURES OF ζ ANDROMEDAE.—Continued.

λ	6429		6441		6446		6457		6466		6478		6491	
	Vel	Wt	Vel	Wt	Vel	Wt	Vel	Wt	Vel	Wt	Vel	Wt	Vel	Wt
4571-958	- 51.32	$\frac{1}{2}$	- 8.09	$\frac{1}{4}$	- 18.30	$\frac{1}{4}$	+ 8.09	$\frac{1}{2}$	+ 4.11	$\frac{1}{2}$	- 39.78	$\frac{1}{4}$	- 35.93	$\frac{1}{4}$
4549-721			- 20.91	$\frac{1}{4}$			- 13.33	$\frac{1}{4}$	+ 3.92	$\frac{1}{4}$	43.26	$\frac{1}{4}$	- 43.78	$\frac{1}{2}$
4415-271	- 44.39	$\frac{1}{2}$	- 21.78	$\frac{1}{2}$	- 20.71	$\frac{1}{2}$	- 5.36	$\frac{1}{2}$	- 4.52	$\frac{1}{2}$	- 21.54	$\frac{1}{2}$		
4404-962	- 48.30	$\frac{1}{2}$	- 36.35	$\frac{1}{2}$	- 14.70	$\frac{1}{2}$	- 13.70	$\frac{1}{2}$	- 12.72	$\frac{1}{2}$	19.60	$\frac{1}{2}$	- 44.76	$\frac{1}{4}$
4340-798	- 36.03	$\frac{1}{2}$	- 11.94	$\frac{1}{2}$	- 13.74	$\frac{1}{2}$	- 8.90	$\frac{1}{2}$	- 9.57	$\frac{1}{2}$	- 31.64	$\frac{1}{2}$	- 64.41	$\frac{1}{4}$
4325-939	- 18.70	$\frac{1}{4}$	- 29.38	$\frac{1}{2}$	- 16.81	$\frac{1}{4}$	- 18.70	$\frac{1}{2}$	- 10.57	$\frac{1}{2}$	- 32.50	$\frac{1}{2}$		
1314-945	- 47.91	$\frac{1}{2}$	- 27.47	$\frac{1}{4}$	- 13.25	$\frac{1}{2}$	- 10.82	$\frac{1}{2}$	- 7.95	$\frac{1}{2}$	27.38	$\frac{1}{4}$		
4289-857	- 43.33	$\frac{1}{4}$	- 12.79	$\frac{1}{2}$	- 14.24	$\frac{1}{2}$	- 2.71	$\frac{1}{2}$	- 10.19	$\frac{1}{2}$	- 23.29	$\frac{1}{2}$		
4271-874	- 50.19	$\frac{1}{2}$	- 9.28	$\frac{1}{4}$	- 17.18	$\frac{1}{2}$	- 5.22	$\frac{1}{2}$	- 4.26	$\frac{1}{2}$	- 26.48	$\frac{1}{2}$		
4260-640					- 22.85	$\frac{1}{2}$	- 15.02	$\frac{1}{2}$	- 12.24	$\frac{1}{2}$	- 22.75	$\frac{1}{2}$		
4215-849	- 40.16	$\frac{1}{2}$	- 29.54	1	- 11.57	$\frac{1}{2}$	+ 0.17	$\frac{1}{2}$	+ 3.54	$\frac{1}{4}$	- 22.25	$\frac{1}{2}$		
4128-031	- 41.38	$\frac{1}{4}$					- 5.12	$\frac{1}{4}$						
4101-820	- 36.02	$\frac{1}{4}$	- 31.93	$\frac{1}{4}$	- 7.06	$\frac{1}{4}$	+ 0.38	$\frac{1}{4}$			- 22.19	$\frac{1}{2}$		
4071-927					- 11.31	$\frac{1}{2}$			- 7.33	$\frac{1}{4}$				
4063-849	- 34.81	$\frac{1}{4}$			- 25.93	$\frac{1}{2}$					- 29.81	$\frac{1}{4}$		
4045-975					- 21.81	$\frac{1}{4}$			- 13.77	$\frac{1}{4}$				
Weighted mean	- 42.20		- 22.54		- 16.68		- 6.08		- 6.63		- 26.87		- 46.53	
V_a	+ 8.21		+ 6.36		+ 5.47		+ 4.94		+ 4.50		+ 3.57		- 0.43	
V_d	- .14		- .04		+ .15		- .02		+ .11		+ .21		- .18	
Curv.	- .28		- .28		- .28		- .28		- .28		- .28		- .28	
Radial Velocity	- 33.8		- 16.5		- 11.3		- 1.4		- 2.3		- 23.4		- 47.4	

MEASURES OF ϵ ANDROMEDAE — *Continued*

λ	6498		6505		6507		6515		6523		6530		6544	
	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.
4571-958			37.26	$\frac{1}{4}$	- 8.49	$\frac{1}{4}$	- 33.02	$\frac{1}{4}$	- 18.56	$\frac{1}{4}$	- 35.01	$\frac{1}{4}$	- 2.76	$\frac{1}{4}$
4549-724	17.08	$\frac{1}{4}$	- 26.14	$\frac{1}{4}$	- 13.20	$\frac{1}{4}$	...		- 7.19	$\frac{1}{4}$	- 30.32	$\frac{1}{4}$	- 18.56	$\frac{1}{4}$
4445-271	- 3.40	$\frac{1}{4}$	...		+ 3.93	$\frac{1}{4}$	- 21.18	$\frac{1}{4}$	- 25.70	$\frac{1}{4}$	- 37.37	$\frac{1}{4}$	- 6.19	$\frac{1}{4}$
4404-962	32.04	$\frac{1}{4}$	...		+ 1.42	$\frac{1}{4}$	- 12.05	$\frac{1}{4}$	- 19.25	$\frac{1}{4}$	- 24.68	$\frac{1}{4}$	- 0.94	$\frac{1}{4}$
4352-006	36.60	$\frac{1}{4}$	- 27.60	$\frac{1}{4}$	- 17.90	$\frac{1}{4}$	...		...		...		...	
4340-708	- 33.00	$\frac{1}{4}$	- 27.70	$\frac{1}{4}$	...		- 16.64	$\frac{1}{4}$	- 12.50	$\frac{1}{4}$	- 40.09	$\frac{1}{4}$	- 4.17	$\frac{1}{4}$
4325-939	28.39	$\frac{1}{4}$	...		- 1.78	$\frac{1}{4}$	- 22.37	$\frac{1}{4}$	- 23.48	$\frac{1}{4}$	- 43.85	$\frac{1}{4}$	...	
4314-945	...		34.68	$\frac{1}{4}$	...		- 27.38	$\frac{1}{4}$	...		- 26.28	$\frac{1}{4}$	- 8.83	$\frac{1}{4}$
4294-528	...		36.30	$\frac{1}{4}$	- 4.64	$\frac{1}{4}$	...		...		...		...	
4289-857	25.23	$\frac{1}{4}$	...		+ 1.08	$\frac{1}{4}$	- 16.13	$\frac{1}{4}$	- 21.34	$\frac{1}{4}$	- 38.45	$\frac{1}{4}$	+ 0.10	$\frac{1}{4}$
4271-874	...		...		6.50	$\frac{1}{4}$	- 23.91	$\frac{1}{4}$	- 34.81	$\frac{1}{4}$	- 34.59	$\frac{1}{4}$	- 6.03	$\frac{1}{4}$
4227-066	...		...		...		...		...		- 33.66	$\frac{1}{4}$	...	
4215-849	20.60	$\frac{1}{4}$	...		- 11.67	$\frac{1}{4}$	- 26.27	$\frac{1}{4}$	- 22.80	$\frac{1}{4}$	- 33.01	$\frac{1}{4}$	- 0.12	$\frac{1}{4}$
4128-031	...		...		- 7.49	$\frac{1}{4}$	...		...		...		...	
4101-820	...		...		...		- 20.43	$\frac{1}{4}$	- 20.52	$\frac{1}{4}$	- 27.94	$\frac{1}{4}$	+ 5.46	$\frac{1}{4}$
4063-849	...		...		- 5.92	$\frac{1}{4}$	...		...		- 18.03	$\frac{1}{4}$	...	
4045-975	...		...		+ 6.26	$\frac{1}{4}$	...		...		...		...	
4005-422	...		...		...		...		...		- 31.72	$\frac{1}{4}$	...	
Wob.	...		...		...		...		...		...		...	
Mean	28.30		- 31.11		- 5.83		- 20.26		- 20.09		- 32.56		- 3.50	
V_x	- 0.87		- 1.35		- 4.32		- 4.83		- 5.33		- 5.72		- 10.54	
V_y	+ 0.04		+ 0.02		- 0.04		- 0.16		- 0.22		+ 0.11		- 0.17	
Curv.	- 0.28		- 0.28		- 0.28		- 0.28		- 0.28		- 0.28		- 0.28	
Round	...		...		...		...		...		...		...	
Velocity	20.1		2.7		10.7		25.5		23.0		38.4		11.5	

MEASURES OF ζ ANDROMEDÆ.—Continued

λ	6551		6558		6560		6570		6581		6585		6590	
	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.
4571.958	+ 9.81	$\frac{1}{2}$	- 27.45	$\frac{1}{2}$	- 24.93	$\frac{1}{2}$	+ 9.14	$\frac{1}{2}$	- 3.38	$\frac{1}{2}$	.....	.....	- 15.37	$\frac{1}{2}$
1549.721	- 4.18	$\frac{1}{2}$	- 36.46	$\frac{1}{2}$	- 9.41	$\frac{1}{2}$	+ 5.76	$\frac{1}{2}$	.....	.....	.....	.....	- 14.06	$\frac{1}{2}$
1415.271	+ 10.23	$\frac{1}{2}$	- 31.30	$\frac{1}{2}$	- 24.39	$\frac{1}{2}$	+ 10.60	$\frac{1}{2}$	.....	.....	- 6.96	$\frac{1}{2}$	- 8.87	$\frac{1}{2}$
1404.962	- 8.50	$\frac{1}{2}$	- 28.11	$\frac{1}{2}$	- 21.97	$\frac{1}{2}$	+ 13.27	$\frac{1}{2}$	+ 0.27	$\frac{1}{2}$	- 16.00	$\frac{1}{2}$	- 12.82	$\frac{1}{2}$
1395.505	.....	.....	- 30.12	$\frac{1}{2}$	- 14.65	$\frac{1}{2}$	+ 17.74	$\frac{1}{2}$	.....	.....	.....	.....	.....	.....
1352.006	.....	.....	- 29.76	$\frac{1}{2}$	- 19.25	$\frac{1}{2}$	.....	.....	- 6.85	$\frac{1}{2}$	- 6.50	$\frac{1}{2}$	- 9.24	$\frac{1}{2}$
1340.798	+ 18.47	$\frac{1}{2}$	- 30.63	$\frac{1}{2}$	- 11.02	$\frac{1}{2}$	+ 12.82	1	- 14.10	$\frac{1}{2}$	- 22.24	$\frac{1}{2}$	- 22.47	$\frac{1}{2}$
1325.939	+ 7.79	$\frac{1}{2}$	- 27.71	$\frac{1}{2}$	- 15.01	$\frac{1}{2}$	+ 7.60	$\frac{1}{2}$	- 7.16	$\frac{1}{2}$	- 24.04	$\frac{1}{2}$	- 22.56	$\frac{1}{2}$
1314.945	+ 13.80	$\frac{1}{2}$	- 30.91	$\frac{1}{2}$	.....	.....	+ 10.23	$\frac{1}{2}$	- 11.72	$\frac{1}{2}$	.....	.....	- 15.50	$\frac{1}{2}$
1294.528	.....	.....	.....	.....	- 12.61	$\frac{1}{2}$	.....	.....	.....	.....	.....	.....	.....	.....
1289.857	+ 4.32	$\frac{1}{2}$	- 24.15	$\frac{1}{2}$	.....	.....	+ 15.21	$\frac{1}{2}$	- 15.26	$\frac{1}{2}$	.....	.....	- 17.11	$\frac{1}{2}$
1271.874	+ 15.06	$\frac{1}{2}$	- 32.68	$\frac{1}{2}$	- 19.76	$\frac{1}{2}$	+ 5.09	$\frac{1}{2}$	- 11.00	$\frac{1}{2}$	- 18.73	$\frac{1}{2}$	- 21.72	$\frac{1}{2}$
1260.640	.....	.....	.....	.....	.....	.....	.....	.....	- 20.56	$\frac{1}{2}$	.....	.....	.....	.....
1227.066	+ 5.58	$\frac{1}{2}$	.....	.....	.....	.....	.....	.....	.....	.....	- 13.42	$\frac{1}{2}$	- 22.94	$\frac{1}{2}$
1215.849	+ 9.05	$\frac{1}{2}$	- 22.77	$\frac{1}{2}$	- 17.97	$\frac{1}{2}$	+ 11.09	$\frac{1}{2}$	- 13.92	$\frac{1}{2}$	- 20.80	$\frac{1}{2}$	- 10.85	$\frac{1}{2}$
1101.820	+ 5.18	$\frac{1}{2}$	- 36.66	$\frac{1}{2}$	- 21.06	$\frac{1}{2}$	+ 23.47	$\frac{1}{2}$	- 26.91	$\frac{1}{2}$	- 14.99	$\frac{1}{2}$	- 32.51	$\frac{1}{2}$
1071.927	+ 13.11	$\frac{1}{2}$	.....	.....	.....	.....	.....	.....	- 9.62	$\frac{1}{2}$	- 15.66	$\frac{1}{2}$	- 23.61	$\frac{1}{2}$
1063.849	+ 7.35	$\frac{1}{2}$	.....	.....	.....	.....	.....	.....	- 10.16	$\frac{1}{2}$	- 11.00	$\frac{1}{2}$	.....	.....
1045.975	+ 14.04	$\frac{1}{2}$	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	- 13.33	$\frac{1}{2}$
Weighted mean	+ 8.31		- 29.27		- 18.05		+ 11.52		- 12.10		- 15.71		- 17.50	
V_s	- 11.43		- 16.66		- 17.05		- 15.43		- 20.84		- 22.54		- 23.10	
V_z	- 0.11		- 0.15		- 0.09		- 0.11		- 0.14		+ 0.04		- 0.06	
Curv.	- 0.28		- 0.28		- 0.28		- 0.28		- 0.28		- 0.28		- 0.28	
Radial Velocity	- 3.5		- 46.4		- 35.5		- 4.3		- 33.4		- 38.5		- 40.9	

MEASURES OF ζ ANDROMEDAE.—*Continued*

λ	6614		6637		6647		6648		6649		6662		6675	
	Vel	Wt	Vel	Wt	Vel	Wt	Vel	Wt	Vel	Wt	Vel	Wt	Vel	Wt
4571 958	+ 15.26	$\frac{1}{4}$	16.41	$\frac{1}{4}$	- 33.89	$\frac{1}{4}$	30.42	$\frac{1}{4}$	2.85	$\frac{1}{4}$	+ 32.98	$\frac{1}{4}$	- 15.90	$\frac{1}{4}$
4549 721	+ 27.11	$\frac{1}{4}$	- 11.95	$\frac{1}{4}$	- 32.42	$\frac{1}{4}$	- 20.62	$\frac{1}{4}$	- 16.68	$\frac{1}{4}$	+ 19.92	$\frac{1}{4}$	- 9.33	$\frac{1}{4}$
4415 271	+ 16.70	$\frac{1}{4}$	12.04	$\frac{1}{4}$	- 24.05	$\frac{1}{4}$	- 15.93	$\frac{1}{4}$	- 10.38	$\frac{1}{4}$	+ 22.43	$\frac{1}{4}$	- 6.72	$\frac{1}{4}$
4404 962	+ 17.07	$\frac{1}{4}$	7.60	$\frac{1}{4}$	- 24.56	$\frac{1}{4}$	- 25.98	$\frac{1}{4}$	- 11.39	$\frac{1}{4}$	+ 29.81	$\frac{1}{4}$	- 13.17	$\frac{1}{4}$
4395 505			- 18.53	$\frac{1}{4}$										
4352 006	+ 19.63	$\frac{1}{4}$	- 11.76	$\frac{1}{4}$	- 28.53	$\frac{1}{4}$	- 17.69	$\frac{1}{4}$			+ 28.75	$\frac{1}{4}$	- 19.97	$\frac{1}{4}$
4340 708	+ 13.61	$\frac{1}{4}$	10.36	$\frac{1}{4}$	35.25	$\frac{1}{4}$	29.42	$\frac{1}{4}$	- 16.59	$\frac{1}{4}$	+ 7.73	$\frac{1}{4}$	- 8.99	$\frac{1}{4}$
4325 939	+ 7.38	$\frac{1}{4}$	- 16.32	$\frac{1}{4}$	- 33.76	$\frac{1}{4}$	- 28.96	$\frac{1}{4}$	- 25.59	$\frac{1}{4}$	+ 26.16	$\frac{1}{4}$	- 7.83	$\frac{1}{4}$
4314 945	+ 24.43	$\frac{1}{4}$	- 14.18	$\frac{1}{4}$	- 39.89	$\frac{1}{4}$	- 35.24	$\frac{1}{4}$	- 17.13	$\frac{1}{4}$	+ 22.10	$\frac{1}{4}$	- 7.17	$\frac{1}{4}$
4294 528					- 24.95	$\frac{1}{4}$	- 32.27	$\frac{1}{4}$			+ 27.57	$\frac{1}{4}$	- 10.10	$\frac{1}{4}$
4289 857	+ 6.50	$\frac{1}{4}$	- 17.31	$\frac{1}{4}$	- 22.66	$\frac{1}{4}$	- 27.90	$\frac{1}{4}$	- 18.19	$\frac{1}{4}$	+ 24.24	$\frac{1}{4}$	- 8.62	$\frac{1}{4}$
4271 874	+ 11.85	$\frac{1}{4}$	- 13.04	$\frac{1}{4}$	- 38.90	$\frac{1}{4}$	- 33.43	$\frac{1}{4}$	- 13.04	$\frac{1}{4}$	+ 20.43	$\frac{1}{4}$	- 20.34	$\frac{1}{4}$
4227 066	+ 12.14	$\frac{1}{4}$												
4215 849			- 15.46	$\frac{1}{4}$	- 32.80	$\frac{1}{4}$	- 13.92	$\frac{1}{4}$	- 8.18	$\frac{1}{4}$	+ 20.86	$\frac{1}{4}$	- 17.00	$\frac{1}{4}$
4101 820	+ 18.81	$\frac{1}{4}$	- 15.43	$\frac{1}{4}$			- 37.17	$\frac{1}{4}$	- 8.55	$\frac{1}{4}$				
4071 927	+ 13.44	$\frac{1}{4}$												
4063 849	+ 20.24	$\frac{1}{4}$												
4045 975	+ 24.30	$\frac{1}{4}$												
Weighted mean	+ 15.99		- 13.61		- 30.87		- 24.80		- 12.93		+ 22.64		- 11.93	
V_a	- 25.05		- 26.23		- 26.99		- 27.19		- 27.32		- 27.90		- 28.65	
V_d	- 0.10		- 0.27		- 0.09		- 0.25		+ 0.04		+ 0.08		- 0.14	
Curv.	- 0.28		- 0.28		- 0.28		- 0.28		- 0.28		- 0.28		- 0.28	
Radial Velocity	- 9.4		9.4		- 58.2		- 52.5		- 40.5		- 5.5		- 41.0	

MEASURES OF ζ ANDROMEDÆ.—Continued.

λ	6676		6684		6690		6724		6728		6772		6775	
	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.
4571.958	- 13.77	$\frac{1}{2}$	- 18.70	$\frac{1}{2}$	- 12.71	$\frac{1}{2}$	- 0.19	$\frac{1}{2}$	- 22.96	$\frac{1}{2}$	+ 24.45	$\frac{1}{2}$	- 35.61	$\frac{1}{2}$
4549.721	- 14.45	$\frac{1}{2}$	- 25.34	$\frac{1}{2}$	- 17.49	$\frac{1}{2}$	- 3.95	$\frac{1}{2}$	- 17.60	$\frac{1}{2}$	+ 27.86	$\frac{1}{2}$	- 15.73	$\frac{1}{2}$
4415.271	- 17.24	$\frac{1}{2}$	- 21.66	$\frac{1}{2}$	- 15.56	$\frac{1}{2}$	- 9.50	$\frac{1}{2}$	.....	$\frac{1}{2}$	+ 32.65	$\frac{1}{2}$	- 25.60	$\frac{1}{2}$
4404.962	- 17.21	$\frac{1}{2}$	- 29.90	$\frac{1}{2}$	- 8.19	$\frac{1}{2}$	- 27.52	$\frac{1}{2}$	- 35.47	$\frac{1}{2}$	+ 26.80	$\frac{1}{2}$	- 25.28	$\frac{1}{2}$
4352.006	- 25.67	$\frac{1}{2}$	.....	$\frac{1}{2}$	.....	$\frac{1}{2}$	.....	$\frac{1}{2}$	- 28.87	$\frac{1}{2}$	+ 34.00	$\frac{1}{2}$	- 32.30	$\frac{1}{2}$
4340.798	- 25.64	$\frac{1}{2}$	- 34.12	$\frac{1}{2}$	- 25.07	$\frac{1}{2}$	- 24.51	$\frac{1}{2}$	- 31.07	$\frac{1}{2}$	+ 8.86	$\frac{1}{2}$	- 34.70	$\frac{1}{2}$
4325.939	- 32.09	$\frac{1}{2}$	- 22.02	$\frac{1}{2}$	- 8.84	$\frac{1}{2}$	- 13.19	$\frac{1}{2}$	- 38.68	$\frac{1}{2}$	+ 18.66	$\frac{1}{2}$	- 27.40	$\frac{1}{2}$
4314.945	- 14.94	$\frac{1}{2}$	- 28.58	$\frac{1}{2}$	- 5.75	$\frac{1}{2}$	- 21.15	$\frac{1}{2}$	- 23.26	$\frac{1}{2}$	+ 19.66	$\frac{1}{2}$	- 36.23	$\frac{1}{2}$
4294.528	- 18.62	$\frac{1}{2}$	- 34.56	$\frac{1}{2}$	.....	$\frac{1}{2}$	.....	$\frac{1}{2}$	.....	$\frac{1}{2}$	.....	$\frac{1}{2}$	.....	$\frac{1}{2}$
4289.857	- 16.13	$\frac{1}{2}$	- 31.25	$\frac{1}{2}$	- 18.98	$\frac{1}{2}$	- 25.81	$\frac{1}{2}$	- 20.04	$\frac{1}{2}$	+ 8.46	$\frac{1}{2}$	- 33.31	$\frac{1}{2}$
4271.874	- 11.11	$\frac{1}{2}$	- 34.29	$\frac{1}{2}$	- 12.83	$\frac{1}{2}$	- 10.47	$\frac{1}{2}$	- 25.27	$\frac{1}{2}$	.....	$\frac{1}{2}$	- 36.32	$\frac{1}{2}$
4215.849	- 15.46	$\frac{1}{2}$	- 26.44	$\frac{1}{2}$	- 11.67	$\frac{1}{2}$	- 15.05	$\frac{1}{2}$	- 27.16	$\frac{1}{2}$	+ 17.52	$\frac{1}{2}$	- 26.96	$\frac{1}{2}$
4101.820	- 15.43	$\frac{1}{2}$	- 27.38	$\frac{1}{2}$	- 19.29	$\frac{1}{2}$	.....	$\frac{1}{2}$	- 23.64	$\frac{1}{2}$	.....	$\frac{1}{2}$	.....	$\frac{1}{2}$
4071.927	.....	$\frac{1}{2}$	- 27.88	$\frac{1}{2}$	.....	$\frac{1}{2}$	.....	$\frac{1}{2}$	.....	$\frac{1}{2}$	.....	$\frac{1}{2}$	.....	$\frac{1}{2}$
4063.849	.....	$\frac{1}{2}$	- 33.88	$\frac{1}{2}$	- 16.11	$\frac{1}{2}$	.....	$\frac{1}{2}$	.....	$\frac{1}{2}$	.....	$\frac{1}{2}$	.....	$\frac{1}{2}$
Weighted mean	- 18.54		- 28.59		- 14.15		- 15.49		- 26.72		+ 20.01		- 29.96	
V ₀	- 28.71		- 28.75		- 28.84		- 28.26		- 27.91		- 26.07		- 24.79	
V ₁	- 0.12		- 0.06		- 0.15		- 0.17		- 0.13		- 0.21		- 0.22	
Curv.	- 0.28		- 0.28		- 0.28		- 0.28		- 0.28		- 0.28		- 0.28	
Radial Velocity	- 47.6		- 57.7		- 43.4		- 44.2		- 55.0		- 6.6		- 55.2	

MEASURES OF ζ ANDROMEDAE.—*Concluded*

λ	6779		6780											
	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.	Vel.	Wt.
4571.958	- 44.85	$\frac{1}{4}$	- 46.62	$\frac{1}{4}$										
4549.721	.....		- 31.20	$\frac{1}{4}$										
4415.271	- 33.40	$\frac{1}{4}$	- 24.16	$\frac{1}{4}$										
4404.962	- 26.10	$\frac{1}{4}$	- 31.66	$\frac{1}{4}$										
4349.798	- 41.01	$\frac{1}{4}$	- 28.14	$\frac{1}{4}$										
4325.939	- 37.90	$\frac{1}{4}$	- 30.50	$\frac{1}{4}$										
4314.945	- 27.38	$\frac{1}{4}$	- 21.90	$\frac{1}{4}$										
4289.857	.....		- 32.58	$\frac{1}{4}$										
4271.874	- 26.34	$\frac{1}{4}$	- 28.70	$\frac{1}{4}$										
4215.849	.....		- 29.01	$\frac{1}{4}$										
4101.820	.....		- 22.70	$\frac{1}{4}$										
Weighted mean	- 35.02		- 29.92											
V_s	- 24.52		- 23.98											
V_r	- 0.26		- 0.23											
Curv.	- 0.28		- 0.28											
Radial Velocity	- 60.1		- 54.4											

The fifty-eight observations were grouped into twelve normal places. These are given in Table IV with the mean Julian day, mean phase, mean velocity, weight and residual from final elements.

TABLE IV
NORMAL PLACES

	Julian Day.	Phase.	Velocity.	Weight.	Residual
1	2,420,190.230	5.922	-18.5	2	-2.7
2	359.875	6.912	-8.4	3	+1.2
3	350.183	8.833	-6.4	3	-1.3
4	433.360	10.173	-6.6	3	+1.1
5	475.258	11.039	-8.7	1	+3.3
6	380.912	12.451	-22.8	3.5	-0.6
7	447.072	14.278	-39.0	5.5	-0.5
8	374.830	16.175	-51.2	4.5	+1.3
9	460.083	0.158	-58.6	4	-2.3
10	354.066	1.830	-48.4	3.5	+1.4
11	463.087	2.578	-43.4	3	+1.0
12	408.999	3.767	-34.5	3	-0.5

Preliminary elements of the orbit were obtained by the application of Dr. King's graphical method. These were,

$$\begin{aligned}
 P &= 17.7673 \text{ days} \\
 e &= .05 \\
 \omega &= 180^\circ \\
 K &= 26 \text{ km.} \\
 \gamma &= -29.70 \text{ km.} \\
 T &= 2,420,024.881 \text{ J. D.}
 \end{aligned}$$

A least-squares solution was carried through to improve, if possible, the elements obtained graphically. The period, obtained by using Lick observations in connection with our own, covering an epoch of 334 cycles was considered as fixed. In the solution, T was also left out on account of the eccentricity being so small, and e , ω , K and γ used.

The following observation equations were formed:—

TABLE V.
OBSERVATION EQUATIONS.

<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>-n</i>	Weight.
1	+ .521	+ .333	+ .821	+ 2.3	2
1	+ .754	- .306	+ .594	- 1.7	3
1	+ .950	- 1.000	+ .016	+ 1.4	3
1	+ .866	- .683	- .412	- 0.5	3
1	+ .717	- .191	- .641	- 2.3	1
1	+ .342	+ .680	- .920	+ 2.0	3.5
1	- .285	+ .902	- .971	+ 1.9	5.5
1	- .864	- .311	- .580	- 1.0	4.5
1	- 1.048	- .992	+ .062	+ 1.6	4
1	- .806	- .126	+ .654	- 2.3	3.5
1	- .595	+ .428	+ .838	- 1.8	3
1	- .190	+ .973	+ .990	- 0.1	3

From these, the following normal equations were derived:—

$$\begin{aligned}
 39.000x - 4.158y + 0.243z - 1.554u + 5.500 &= 0 \\
 19.772y - 1.303z - 0.773u + 5.948 &= 0 \\
 18.848z - 1.843u + 8.004 &= 0 \\
 19.547u - 20.759 &= 0
 \end{aligned}$$

The solutions of the normal equations gave,

$$\begin{aligned}
 x &= - .132 \\
 y &= - .312 \\
 z &= - .346 \\
 u &= + 1.006
 \end{aligned}$$

from which,

$$\begin{aligned}
 \delta\gamma &= - .13 \text{ km.} \\
 \delta K &= - .31 \text{ km.} \\
 \delta e &= - .013 \\
 \delta\omega &= + 2^\circ.22
 \end{aligned}$$

Hence the new values of the elements:—

$$\begin{aligned}\gamma &= -29.83 \\ K &= 25.69 \\ e &= .037 \\ \omega &= 182^{\circ}.22 \\ T &= 2,420,024.881 \text{ J. D., as before.}\end{aligned}$$

These new values of the elements gave a reduction of Σpv from 107 to 81 or about 25 per cent. The residuals computed from the orbital elements and those from the observation equations were very nearly identical and no further corrections were attempted.

The probable error of a normal place is ± 2.1 and that of a single observation of average weight ± 2.8 . The probable errors of the various elements are given after the final values in the summary following.

SUMMARY.

Element.	Preliminary.	Final.	Probable Error.
P	17.767 days	17.7673 days	
e	.05	.037	$\pm .022$
ω	180°	$182^{\circ}.22$	$\pm 1^{\circ}.27$
γ	-29.70 km.	-29.83 km.	± 0.40 km.
K	26 km.	25.69 km.	± 0.57 km.
T	2,420,024.881 J. D.	2,420,024.881 J. D.	
$a \sin i$		6,272.000 km.	

In the figure the circles are Ottawa normal places and the circles crossed are Lick observations. It will be seen that if the whole curve were raised about 3 km. the Lick observations would be better satisfied. This is probably due to different wave-lengths being used, or perhaps, to some extent, to the fact that no doubt in the work here many of the lines measured are blends. Any change in the period does not seem to bring the Lick observations closer to the curve given by our own observations.

Dominion Observatory,
Ottawa,
February, 1915.



